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# FRAMING GLOBAL BIODIVERSITY: IPBES BETWEEN MOTHER EARTH AND ECOSYSTEM SERVICES

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The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is an emerging expert advisory institution that aims at tackling the loss of biodiversity and the degradation of ecosystem services. Building on the experience of the Intergovernmental Panel on Climate Change and on previous biodiversity-related assessments, IPBES aspires to create a new type of science-policy interface: achieving balance between developed and developing countries, and being inclusive of different disciplines and knowledge-systems. While competing framings and discourses about biodiversity are expressed in these global settings, IPBES has also adopted a single conceptual framework to support its work. Yet, this process was punctuated by many debates and the notion of 'ecosystem services' was contested. This paper uses Sciences and Technology Studies (STS) concepts and methods to investigate the development of the IPBES conceptual framework during the period 2012-2014. In particular we ask whether, and how, debates amongst participants about the nature of knowledge, the relationship between humans and nature, and about the meaning of 'ecosystem services' were reconciled through this process. We discuss what is achieved by the IPBES conceptual framework and whether it could prove itself a boundary object. Our findings serve to highlight the multiple ways in which the science-policy interface is being imagined and to reveal some of the challenges awaiting biodiversity governance as ontological and epistemic plurality is embraced at a global scale.

Keywords: IPBES, Ecosystem services, Mother Earth, Science-policy interface, Boundary object, Expertise

## 1. Introduction

Over the past 30 years, the institutional landscape of global environmental governance has been marked by the multiplication of expert organizations whose aim is to provide policy-relevant knowledge. In the field of biodiversity governance, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), formally established in 2012, is the most recent example of such mechanisms. In seeking to provide policy-relevant knowledge to tackle the loss of biodiversity and degradation of ecosystem services, IPBES builds on previous initiatives carried out in the field of biodiversity, outstanding examples of which include the Global Biodiversity Assessment (GBA, 1995) and the Millennium Ecosystem Assessment (MA, 2005).

While becoming increasingly in demand, the design and execution of global expert organizations have also been contested (e.g. Scoones 2009). IPBES seeks to build on previous experience by designing a new type of science-policy interface, tailored for biodiversity issues, but also with a good balance between developed and developing countries and build on a broad knowledge-base: inclusive of natural science, social sciences, and traditional and indigenous knowledge (IPBES 2012). This call to adopt an innovative institutional design, and more inclusive processes, has been formulated by both practitioners and academics (Koetz et al. 2011; Hulme et al. 2011; Turnhout et al. 2012). To draw on Stirling's metaphor (2008), in many respects IPBES aspires to "open-up" science-policy interfaces and to encompass a broad range of actors and knowledges. In analysing the development of the IPBES conceptual framework, this study seeks to build on social science and STS studies scrutinizing the governance of global environmental expertise (Scoones 2009; Hulme & Mahony 2010; Beck et al. 2014). In light of its ambition to provide a global overarching vision, the construction of this framework enables us to examine how IPBES attempts to accommodate multiple, and often divergent, perspectives on biodiversity and ecosystems in practice.

The IPBES conceptual framework was officially adopted in December 2013 during the second plenary session of IPBES (known as IPBES-2). State delegations as well as observers (e.g. representatives of NGOs, research institutes, representatives of Indigenous People) gathered for a week in a vast conference centre in Antalya, Turkey. The development of the framework was one of the first tasks initiated by IPBES in 2012 and it has been described as:

> "A concise summary in words or pictures of relationships between people and nature. (…) [It] provides common terminology and structure for the variables that are of interest in the system of interest." (UNEP 2013a:11)

According to the IPBES website[1], the purpose of this framework is to "support the implementation of all four functions of the Platform – knowledge generation, assessment, policy support tools and capacity-building. [It] helps to ensure coherence and coordination among these four functions". When it was presented during IPBES-2, three distinctive features of this framework were highlighted: (1) in the process leading to its adoption efforts were made to be inclusive of different voices in order ensure credibility and legitimacy; (2) the IPBES framework placed "institutions" and not "nature" at the centre stage, hence highlighting the importance of socio-political aspects to adequately manage biodiversity and ecosystem services; and (3) the framework embraced different knowledge-systems by means of a colour code. For this reason, it has been referred to as a 'Rosetta Stone': "the conceptual framework can be thought of as a kind of Rosetta Stone that highlights commonalities between diverse value sets and seeks to facilitate crossdisciplinary and crosscultural understanding"(Díaz et al. 2015a:1).

[1] http://ipbes.net (last accessed, March 2nd, 2015)

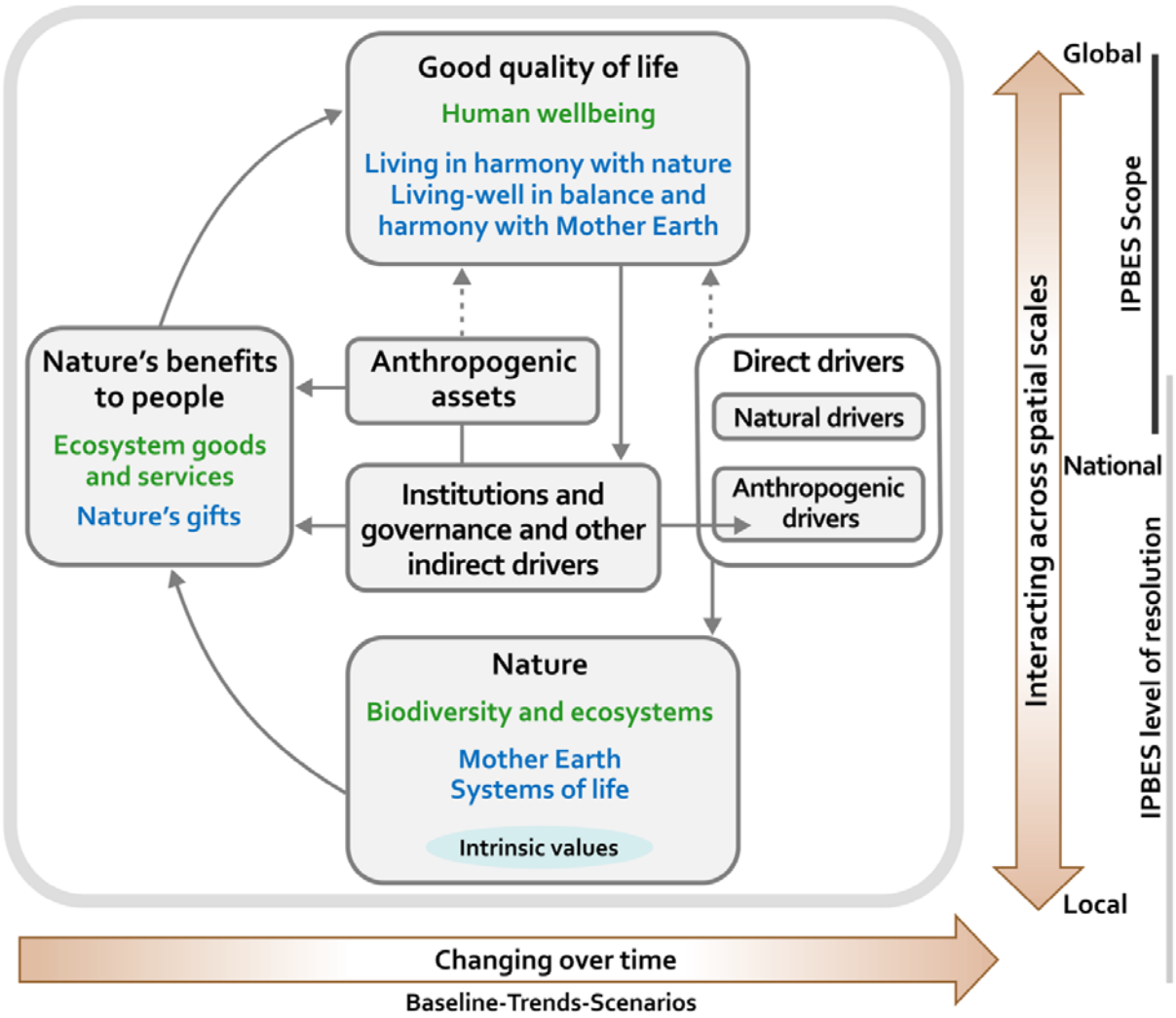


***Fig 1**. Conceptual Framework of the Intergovernmental Platform on Biodiversity and Ecosystem Services (Reproduced after Diaz et al. 2015a; 2015b, with permission from the authors).*

The adopted framework is summarized in a diagram (figure 1) representing the relationship between humans and nature by means of six boxes connected with arrows. A colour code is used to represent different perspectives on biodiversity: black is used for the categories that are consensual (e.g. Nature, Nature's benefit to people, good quality of life); green is used to represent the view of actors framing biodiversity in terms of ecosystem services (e.g. Biodiversity and ecosystem, Ecosystem goods and services, Human well-being); and blue is used to represent the view of actors framing biodiversity through the concept of Mother Earth (e.g. Mother Earth, Systems of Life, Nature's gifts, Living in harmony with nature). More details on these two framings will be given in sections 3 and 4 of this paper.

Previous initiatives in the field of biodiversity and ecosystem services assessments have also adopted a common conceptual framework. The most prominent example of these is the conceptual framework of the Millennium Ecosystem Assessment (MA). This was organized around different categories of ecosystem services - i.e., supporting services, regulating services, provisioning services and cultural services (MA 2003; Carpenter et al. 2009) - and it

acted as an important reference point for many participants involved in the IPBES process. In contrast to this initiative, IPBES operates in intergovernmental settings. In this respect it shares numerous similarities with the Intergovernmental Panel on Climate Change (IPCC) and has often been referred to as an "IPCC-like mechanism for biodiversity"(Larigauderie & Mooney 2010). The plenary - the Assembly of States' delegates[2] - is the main decision-making part of IPBES governance structure and its work is supported by two subsidiary bodies: a Bureau in charge of performing administrative functions as defined by the plenary, and a Multidisciplinary Expert Panel (MEP) in charge of performing scientific and technical tasks.

Yet, the process leading to the adoption of the IPBES conceptual framework was far from easy and the diagram underwent numerous changes and was the centre of heated debates, in particular around the notion of "ecosystem services". In this paper, we approach the IPBES conceptual framework both as a process and as a product and our objective is twofold. First, by focusing on the process that led to the framework's adoption, we seek to reveal the debates and difficulties that surrounded its conception and, second, considering the framework as a product, we ask: what ontological, epistemic or political settlement does this framework achieve? The remainder of the paper is organized as follows: in Section 2 we summarize our concepts, methods, and materials. Section 3 presents the main events and participants involved in the development of the IPBES conceptual framework. Section 4 focuses on the content of the debates and in particular on a controversy between participants framing biodiversity in terms of "ecosystem services" and those framing biodiversity in terms of "Mother Earth". Finally in Section 5 we discuss how different perspectives were accommodated in the IPBES conceptual framework and whether it might be understood as a boundary object. We offer some concluding remarks in Section 6.

## 2. Concepts, methods, and materials

Conceptually, this paper builds on the co-productionist idiom which suggests that science and policy, rather than being understood as two distinct realms, should be understood as mutually co-produced. That is to say, the understanding that: "the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it" (Jasanoff 2004a:2). This also implies that in seeking to understand the development of the IPBES framework process and outcome cannot be separated. Although framed as a scientific task, the making of the IPBES framework was a collaborative process inclusive of heterogeneous groups: natural scientists, social scientists, MEP experts, IPBES Bureau members, representatives of indigenous and local knowledge, United Nations officers, States delegates.

[2] In March 2015, IPBES gathers 124 States.

While not explicitly associated with the co-productionist idiom, the social worlds framework (Clarke 2005) is an approach particularly used amongst STS scholars and is theoretically consistent with Jasanoff's approach in that they share a constructivist stance. In particular, Clarke's situational analysis, drawing together elements from the social world framework and Actor-Network Theory (ANT) provides useful conceptual resources to explore collective process of meaning-making while being attentive to the importance of non-humans and materials in social interactions (Clarke & Star 2008). This is particularly valuable for tracing the origins, circulation, and evolution of the IPBES conceptual framework.

In this respect, the IPBES framework is much more than a flat or static diagram: each category and its relationships to the other boxes were carefully crafted. Therefore to understand how this framework was formed it is important to consider the process that led to its adoption and the dynamics animating its production. As Fyfe and Law (1988:1) explain:

> "A depiction is never just an illustration. It is the material representation, the apparently stabilised product of a process of work. And it is the site for the construction and depiction of social difference. To understand a visualisation is thus to inquire into its provenance and into the social work that it does. It is to note its principles of exclusion and inclusion, to detect the roles that it makes available, to understand the ways in which they are distributed, and to decode the hierarchies and differences that it naturalises."

Drawing on ANT, each inscription in the IPBES framework can be understood as resulting from a successful attempt by an actor, or group of actors, to convey their view and convince other groups. This suggests an understanding of translation not in a linguistic sense but rather as:

> "All the negotiations, intrigues, calculations, acts of persuasion and violence thanks to which an actor or force takes, or causes to be conferred on itself authority to speak or act on behalf of another actor of force" (Callon & Latour 1981:279)

This entails understanding the IPBES diagram as representing, by means of these inscriptions, several successful translations. Throughout the process, the choice of the categories to be used, as well as the terminology and the direction of arrows, was at the core of endless debates. The controversy around the notion of ecosystem services is only the most visible aspect of the numerous debates that animated the construction of the conceptual framework. Finally, in asking what is achieved by this framework we discuss whether it could itself function as a 'boundary object' (Star & Griesemer 1989) facilitating the inclusion of different forms of knowledges. This concept will be further explained and developed in Section 5.

Empirical materials for this study come from 10 semi-structured interviews conducted between December 2013 and February 2014 with experts who were all involved in the conception of the framework and had substantial roles in this process (Table 1). Some of these experts were interviewed twice (A, C, I). In addition to these interviews we also rely on participant observation of two IPBES plenary session: IPBES-1 held in Bonn, Germany (21-26 January 2013), during which an initial framework was presented; and IPBES-2 held in Antalya, Turkey (9-14 December 2013), during which the framework was adopted. A corpus of texts including official IPBES documents, workshop reports, and all the comments received on the framework (made available online) provides the basis for document analysis. Interviews and all relevant documents have been analysed using an interpretivist approach inspired by grounded theory (Charmaz 2006).

| Interviewee | Disciplinary background | Geographic location | Relation with IPBES |
|---|---|---|---|
| **A** | Natural scientist | Europe | IPBES interim Secretariat |
| **B** | Natural scientist | Europe | Contributing expert |
| **C** | Economist | Europe | Contributing expert |
| **D** | Natural scientist | Africa | Contributing expert |
| **E** | Social scientist | North America | Contributing expert |
| **F** | Social scientist | South America | Member of IPBES delegation |
| **G** | Natural scientist | Africa | Member of the MEP |
| **H** | Social scientist | Africa | Member of the MEP |
| **I** | Natural scientist | North America | Member of the Bureau |
| **J** | Social scientist | South America | Member of IPBES delegation |

**Table 1**: Overview of experts 'profiles interviewed on the IPBES conceptual framework.

## 3. Following the IPBES conceptual framework

### 3.1. From Panama to Antalya: overview of the process

Following the decision to establish IPBES, made in Panama in April 2012 (Fig. 2), representatives of Member States gave the United Nations Educational, Scientific and Cultural Organization (UNESCO) the mandate to start reflecting on the conceptual framework for the Platform in collaboration with the International Human Dimension Programme (IHDP), DIVERSITAS[3] and the Institute for Sustainability and Peace of the United Nations University. At that time IPBES was at a very early stage in its development and while it had been agreed that IPBES would have two subsidiary bodies (the Bureau and MEP), members of these bodies had not yet been nominated.

[3] DIVERSITAS is an international programme focused on biodiversity science, see Larigauderie et al. 2012.

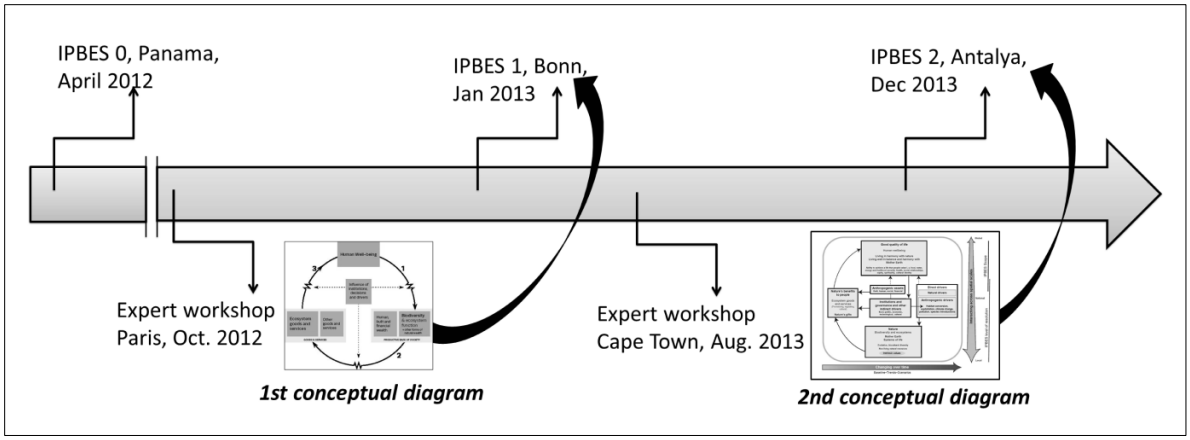


***Fig. 2*** *Chronology of main events punctuating the development of the IPBES conceptual framework, April 2012 to December 2013.*

Under the auspices of UNESCO, an expert workshop gathering of around 30 participants was convened in Paris in October 2012. Following this event, the first conceptual diagram (fig.3) was presented in Bonn, in January 2013, during a side-event of the first official plenary session of IPBES (UNEP 2013a). The second major workshop took place in Cape Town, South Africa, in August 2013 (UNEP 2013b).

### 3.2 The Paris workshop

Under the leadership of UNESCO a small organizing committee was created, comprising Salvatore Arico (ecologist, UNESCO), Neville Ash (ecologist, UNEP), Eduardo Brondizio (anthropologist, Indiana University, USA), Anne Larigauderie (ecologist, Executive director of the International Council for Science), Georgina Mace (ecologist at University College London, head of DIVERSITAS), Kazuhiko Takeuchi (geographer, Vice-rector of the United Nations University, Tokyo) and Pierre Commenville (ecologist, International Union for Conservation of Nature). The selection of experts for the workshop was rather informal: a list of invited experts was established by the organizing team, in association with the IPBES interim Secretariat. These experts were chosen to be representative of a broad range of geographical locations (namely to have a North/South balance), of disciplines (ecologists, economists, anthropologists were invited), and also of different areas of expertise (including marine sciences, forestry, genetic resources). It was an academic workshop: almost all of these experts had a PhD and most were still working either in a research institute or in academia. A fair number of them also had experience with global change research programmes such as DIVERSITAS and IHDP.

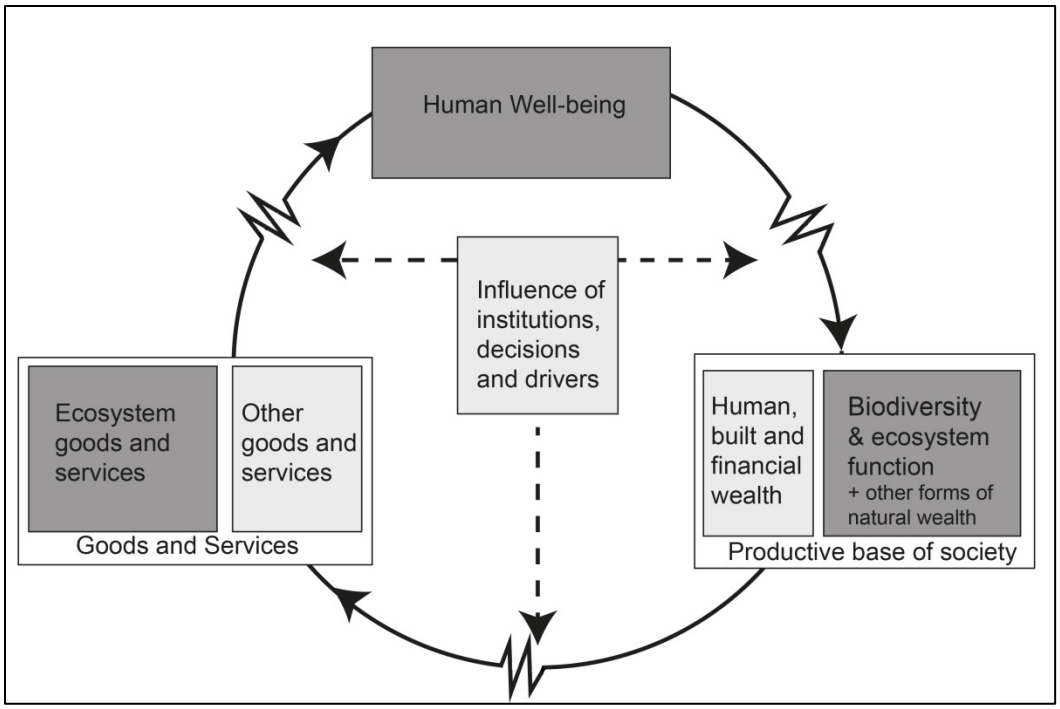


***Fig. 3*** *First conceptual diagram, outcome of the Paris workshop in October 2012 (Adapted from UNEP 2013a:9 with permission)*

Some exchanges took place before the workshop and a framing paper outlining some ideas for a potential framework was circulated. This document was written beforehand by five experts, who were also at the Paris workshop, all of them having wide-ranging experience of global change research and of global biodiversity assessments (particularly the MA). It also presented a sample of conceptual frameworks used in other initiatives such as the MA, the Inclusive Wealth Report, the United Kingdom National Ecosystem Assessment and TEEB (the Economics of Ecosystem and Biodiversity). The drafting of the framework was overseen by Anne Larigauderie and Anantha Duraiappah (economist, IHDP). During the process, participants were also encouraged to pursue their work online by means of a virtual platform, set up to encourage discussion in a transparent manner. The idea was to limit private emails and to encourage collective thinking.

### 3.3 The inter-sessional process and Mother Earth

After the Paris workshop, the proposed conceptual framework was made available online and open for comments to IPBES Members States and to civil society organizations. This process allowed several positions to be made visible – some delegations welcomed the suggested framework (e.g. India), some expressed moderate criticisms, many remained silent – and the delegation of Bolivia, supported by other South American delegations from the ALBA[4], strongly advocated against it. The Bolivian delegation rejected the suggested

[4] ALBA (Alianza Bolivariana para los Pueblos de Nuestra América) is an intergovernmental organization including Antigua and Barbuda, Bolivia, Cuba, Dominica, Ecuador, Nicaragua, Saint Lucia, Saint Vincent and the Grenadines and Venezuela.

framework and put forward an alternative proposal based on the idea of "Mother Earth". After the IPBES Plenary in Bonn in January 2013, arguments arose between participants supporting the initial Paris framework and those advocating for an alternative proposal. As emphasized by some participants in the Paris workshop:

> "There was a clear divide between what we drafted as a conceptual framework for discussion at the Bonn plenary meeting and there were many comments especially coming from countries like Bolivia that really clashed with the conceptual framework that we were proposing" (Interviewee C)

> "It is a completely different framing and they were very concerned and they raised this at the Bonn meeting, we missed out on Mother Nature completely" (Interviewee B)

In Bonn, the experts of the Multidisciplinary Expert Panel (MEP) and members of the Bureau were nominated. For the MEP, five experts were selected for each United Nations region (Western Europe and Others Group, Eastern Europe Group, Latin American and Carribean Group, Asia-Pacific Group, African Group). The task of continuing the work on the conceptual framework was then formally handed over to these freshly nominated MEP members who had to address the comments and deal in particular with the Bolivian contestation.Two MEP members, Sandra Diaz (Argentina) and Sebsebe Demissew (Ethiopia) played a particularly significant role in the process and acted as co-chairs in the Cape Town workshop, in August 2013. This second major workshop can then be seen as an attempt to find an agreement between these diverging voices. In the context of IPBES governance, States have the executive power and consensus is generally the rule for decision-making (see IPBES 2012). This means that for the process to move forward an agreement needed to be found between all States' delegates, and in this case more particularly with Bolivia.

### 3.4 The Cape Town workshop

Both the Paris and the Cape Town workshops were landmark events in the process leading to the IPBES framework and they share some similarities. Both were framed as *expert* workshops and approached the making of the framework as a *scientific* task; in other words participants were not intended to represent anything but their scientific skills. In both cases much emphasis was put on the importance of having an inclusive process and to bring together different (geographical, cultural, disciplinary, gendered) perspectives. Beyond the physical settings of the workshop venues there were also numerous online exchanges throughout the process.

However, the characteristics and dynamics of the two events were very different (Table 2). To access the Cape Town workshop participants had to be nominated by a government and the selection process was more formal and less flexible than for the Paris workshop. Only a small number of experts were present at both workshops. In addition to these experts, a

significant number of MEP and Bureau members of IPBES were also present at the Cape Town workshop:

> "One of the problems at this meeting was that there was 30 experts plus a lot of MEP members plus a lot of Bureau members so it was a very big meeting and the roles of these different groups were not entirely clear" (Interviewee B)

Moreover, the Cape Town workshop took place after the contestation by Bolivia and this affected its agenda as well as the list of participants: for example, the head of the Bolivian delegation, who was not in Paris, was present at the Cape Town workshop. Between the two events, the framework underwent numerous changes and there was a countless number of intermediary drafts.

| | PARIS WORKSHOP | CAPE TOWN WORKSHOP |
|---|---|---|
| **Official name** | Informal expert workshop on main issues relating to the development of a conceptual framework for the IPBES | Expert workshop on the conceptual framework for IPBES |
| **Date & Place** | 29-31st, October 2012<br>Paris, France | 25-26th, August 2013<br>Cape Town, South Africa |
| **Main convenor** | UNESCO | IPBES Multidisciplinary Expert Panel |
| **Supported by** | Government of Japan, IUCN, DIVERSITAS, IHDP | Governments of South Africa, Japan and United Kingdom |
| **Access to the workshop** | Following IPBES Plenary-1 in Panama (April 2012) a steering committee was formed and invited participants to the workshop based on their scientific expertise. | IPBES members and observers were invited to nominate experts to the workshop, more than 100 nominations were received and the MEP members selected 5 members per UN region. |
| **Participants *(number)*** | • Experts *(31)*<br>• Observers *(8)* | • Experts selected by the MEP *(23)*<br>• Representatives of the IPBES workshop on Indigenous and Local Knowledge Systems *(3)*<br>• Representative of MEA Scientific Subsidiary Body *(1)*<br>• Representatives of UN Agencies *(5)*<br>• IPBES Bureau and MEP members *(29)* |
| **Chairs of the workshop** | Eduardo Brondizio (anthropologist); Georgina Mace (ecologist) | Sandra Diaz (ecologist, MEP member, Argentina); Sebsebe Demissew (botanist, MEP member, Ethiopia) |

**Table 2:** Main characteristics of two landmark workshops *(Information compiled in this table comes from the official reports of each workshop, both available online, see UNEP2013a, 2013b)*

This points towards a key difference between the two events: while the Paris workshop was mostly framed as a conventional scientific workshop gathering mostly academics, in the Cape Town workshop, political and epistemic concerns could not easily be distinguished. Participants were more heterogeneous, in terms of their affiliations and backgrounds, and often acted both as experts and national, or sectoral, representatives.

## 4. Developing the IPBES conceptual framework

### 4.1. A successful translation: social scientists and 'institutions'

A similarity between the Paris and the final Cape Town diagrams lies in the fact that they both place "institutions" centre stage. Initially, several participants thought that, given that the focus of IPBES is biodiversity and ecosystem services, then "nature" ought to be at the core of the framework. However, recent discussions taking place under the Convention on Biological Diversity, with the adoption of the new 2020 Aichi Biodiversity Targets, have recognized the importance of institutional settings ('indirect drivers') to address biodiversity issues (CBD 2010) and since the beginning of the IPBES process much emphasis has been placed on the need to be inclusive of social scientists (e.g. Mooney et al. 2013).

This move also echoes a broader pattern in global change research where several scholars have called for the participation of social sciences in the framing of global change issues in order to favour more pluralist approaches (Hulme 2011; Palsson et al. 2013; Sörlin 2013). This contrasts, for example, with the approach adopted by the IPCC where the framing of climate change is predominantly based on natural sciences (Bjurström & Polk 2011; Hulme & Mahony 2010). Some social science experts were present at both workshops. They argued that to appropriately tackle biodiversity and ecosystem services degradation, institutional settings should be taken into consideration:

> "I believe, as a social scientist, that if IPBES was going to have, to make, any impact whatsoever it would need to put that understanding of the relevance of social interactions and institutions at the centre, at the core of the conceptual framework, which is something that, for example, the Millennium Ecosystem Assessment did not do" (Interviewee C)

Underlying this view is the conviction that in tackling biodiversity issues the need is not only scientific knowledge on the state of ecosystems, but also alertness to the way ecosystems are governed, for example by analysing public subsidies that may have harmful effects on ecosystems. This argument was successful and most of the experts already involved in the Millennium Ecosystem Assessment regarded this as an important improvement in contrast to this previous initiative.

Following the debates between "ecosystem services" and "Mother Earth" it was also argued that having "institutions" as the centre of the conceptual framework was appropriate since it could serve to convey the view that value-systems are socially constructed and result from complex socio-cultural processes. In this respect, "institutions" serve not only to convey an understanding of biodiversity issues as related to governance settings, but also appear as a way to articulate different value-systems. It puts in equivalence two different systems: a utilitarian one focused on ecosystem services and a holistic one based on the idea of Mother Earth.

### 4.2 A contested category: ecosystem services

In the Paris diagram there is no mention of the intrinsic value of biodiversity – that is the idea that biodiversity has value in itself, independently of people's use or perception of it. The rationale for this choice lies in the fact that, although sympathetic to the idea of intrinsic value, many participants in the Paris workshop thought that it was not relevant to the work of IPBES and this choice was deliberate:

> "There is a philosophical discussion about whether ecosystem service is an anthropocentric idea as opposed to a pancentric idea and some of these indigenous knowledges are very much based on a pancentric view, in other words the value is intrinsic in nature and not in the human use of nature. (…) I agree that this can be believed, but we are humans and the only possible way we can perceive is through our humanness. In other words, if there is value in nature outside of human perceptions, by definition we cannot engage with it because the only way to engage is through human perception. So to some extent this debate is displaced, it is not a practical way."(Interviewee D)

Nevertheless, the Paris diagram was perceived as too utilitarian by a wide range of actors, not just those from South America, but also some from European countries (e.g. Germany, the United Kingdom) and Asia-Pacific (e.g. New Zealand, Japan). Their comments emphasized that it did not adequately reflect the plurality of values that can be attributed to biodiversity. There was a wide array of positions among participants and the notion of ecosystem services served as a site of controversy between the two extreme ends of the spectrum.

#### 4.1.1. The Bolivian critique

The major criticism of the Paris diagram was articulated by the Bolivian delegation, led by Diego Pacheco, an anthropologist by training. The Government of Bolivia has been questioning the concept of ecosystem services since the beginning of the IPBES process and advocating similar positions in other forums of environmental governance (e.g. IPCC, Convention on Biological Diversity). Other South American delegations were supportive of this view, but it was the Bolivian delegation who formulated and advocated most vehemently for an alternative, more holistic, framing:

> "The Plurinational State of Bolivia disagrees with the content of the proposed conceptual framework because it only represents the views, visions and approaches of the Western modern society and it is completely biased towards a particular vision of biodiversity which is the one related to the commodification of nature." (Alternative Bolivian proposal, 2013, p2)

As suggested in the quote above, the Paris diagram was rejected on the basis that it was representative of a western vision of biodiversity, framed in terms of ecosystem services, and the suggestion that such a notion was synonymous with the commodification of nature. The Bolivian critique also depicts "western modern society" and "non-western, indigenous people and local communities" as two blocks differing in every possible aspect including ethical values, economy, policy, environment and religion.

In response to the "western view", Bolivia proposed an alternative framework that of living-well in balance and harmony with Mother Earth. This position mirrors a law which has been adopted in Bolivia, the "Law of the Rights of Mother Earth" which attributes rights to nature (Bolivia, Law 071, 2010). As outlined in the Bolivian proposal:

> "The concept of Mother Earth is completely different than nature. Mother Earth is a living system or living being. This would imply saying that nature is considered as a living being with specific "rights", paralleling "human rights". In conclusion, Mother is "our mother and therefore is not an object to be exploited by human beings"." (Alternative Bolivian proposal, 2013, p7)

In addition to this key entity of Andean cosmology, the Bolivian framework is based extensively on the work of Elinor Oström (whom the head of the Bolivian delegation studied with for his PhD at Indiana University) and argues that environmental goods and functions should not be delivered by private markets but rather by public entities (e.g. Ostrom 1990). In particular, the framework builds on the idea of polycentric governance "characterized by multiple governing authorities at differing scales rather than a monocentric unit" (Ostrom 2010:552) and advocates for the adoption of multi-level institutional arrangements.

In rejecting the notion of ecosystem services, the Bolivian proposal also underlines the importance of traditional and indigenous knowledge. The promotion of Mother Earth appears as a way to open a space for other ways of knowing that do not necessarily fall into the ecosystem services paradigm. In this view, the conceptual framework is:

> "An instrument to guide the relationship between human beings, biodiversity and environmental functions, and help to create linkages for the articulation between indigenous knowledge systems of indigenous people and the modern science." (Alternative Bolivian proposal, 2013, p15)

While criticizing ecosystem services on the basis of its utilitarian grounding is common – many States including in the western world thought that the Paris diagram was too utilitarian, Mother Earth's advocates immediately connected it with a particular global imaginary, that of hegemonic capitalism. Concurrently, ecosystem services appear here to be a way to hand western science a predominant role in IPBES.

### 4.2.2 Preserving ecosystem services

For experts among the ecosystem services community, the adoption of the notion is based on several concerns. First, to a large extent IPBES is perceived by many natural scientists as an opportunity to build on previous initiatives in the field of biodiversity sciences. For this reason, there was a strong pressure to maintain some epistemic consistency, most particularly with the classification of ecosystem services promoted in the MA. In this respect, many natural scientists saw the development of the framework as an opportunity to improve and clarify the definition of the different types of ecosystem services, as well as their relations with biodiversity and human well-being.

For example, many thought that the way in which 'supporting services' was defined in the MA was not entirely satisfying:

> "Supporting services ends up being a bit of a problem because this is really just fundamental ecological things, this is what ecosystems will do even if people were not here (nutrient cycling, water cycling,…), they do that all by themselves, so in a way it's part of nature itself, it's part of biodiversity, so they were always slightly awkward [in the MA]. You had to make it the underpinning and then when you do valuation it is difficult. Now, they are hidden in here somewhere: 'life support systems', and that is where supporting services have gone and there is generally agreement amongst ecosystem services people (…)." (Interviewee B)

In this perspective, rather than giving up the notion of ecosystem services what is needed is to build on the existing categories in order to strengthen their analytical robustness, with the underlying assumption that this will facilitate the development of better ways to quantify and assess these ecosystem services and the benefits they provide to society. A similar concern animated the notion of 'cultural services':

> "The problem with cultural services is that they end up being the same thing as intrinsic value if you are not really careful. So the way this works is, intrinsic value in theory is the value of something irrespective of the human use of it, so pigeons for themselves, or nature for itself, what that means is that you can't make any decisions about it." (Interviewee B)

Second, the notion of ecosystem services is often regarded as the most effective, or pragmatic way, to convey biodiversity-issues to decision-makers. In this respect, ecosystem services are often defended as an ideologically-neutral notion:

> "This notion that ecosystem services are the benefits that people get from nature is fairly independent of any ideology. The opponents of that tend to argue that it is a capitalist notion but I don't see it as a capitalist notion, I think there are things that you get and some come from nature, that does not make it a capitalist view or an exploitationist view."(Interviewee D)

Although some ecosystem services experts had sympathy with the idea of Mother Earth, many perceived its adoption and promotion as a political position, not analytical enough to be workable.

> "I understand where it is coming from but the key drivers of this are political and have a lot to do with the emergence of the promotion of indigenous knowledge systems particularly in parts of South America as a counter to what is seen as a western ideology. (…)
>
> When you start trying to unpack that at the level of the conceptual framework it typically emerges that the conceptual framework that emerges is just the one that is actually provided in the scientific circles but with different words attached." (Interviewee D)

This points towards key differences between the two groups regarding the meanings given to the 'ecosystem services' concept. For the ecosystem services community, ecosystem services appear predominantly as an epistemic notion, but which is also a pragmatic way to frame biodiversity-issues. There is nothing intrinsically suspect about ecosystem services. It is a concept for linking scientific knowledge on biodiversity with policy-making processes. Clarifying the definition of the different types of ecosystem services, and their relation with biodiversity and human well-being, is important to facilitate better ecosystem management (e.g. Mace et al 2012) and valuation practices. Similarly, having "institutions" at the core of the diagram was generally regarded as an improvement in contrast to the MA conceptual framework – a necessary improvement for IPBES to have any policy-relevant impact.

For Mother Earth's advocates, however, ecosystem services is understood as performing a certain ordering of the world, one which they deeply contest. It is not an ideology-free, or value-free, notion. The rejection of ecosystem services reflects an understanding of the concept as anything *but* a neutral vehicle. It is rather perceived as the manifestation of nature's commodification. In light of this understanding of ecosystem services, not only would the notion not solve the biodiversity crisis, it would make it worse. This view resonates to a certain extent with the academic critique which questions the notion of ecosystem services – what does this framing mean in practice? - and is alert to its performative effects (Ernstson & Sörlin, 2013; Turnhout et al. 2013; Turnhout et al 2014).

### 4.3 Mediating experts: 'No one wants to commodify nature'

The controversy over the Paris diagram triggered many debates and interactions between different groups of participants. In this context, some experts played a particularly important role by being able to connect with different groups and encourage dialogue, in particular between the community of ecosystem services experts and delegates of South American countries.

494 "I was playing some sort of bridge, bridging between Bolivia and other scientists, so that
495 other scientists could understand that the Bolivian delegation wanted to be very
496 constructive but they also wanted to show that their view and IPBES and the conceptual
497 framework was developing in a different way. I was acting as a diplomat trying to broker
498 a deal between the scientific community and delegations like the Bolivian one and at the
499 end it worked really well" (Interviewee C)

500 As highlighted in this quote, the process of producing the diagram allowed fruitful
501 interactions to take place. Some experts acted as mediators, using their interactional
502 capacities to find solutions between diverging views and were key in building trust to allow
503 the process to move forward. Behind the scenes, there was also a real effort to understand
504 how the view of 'Mother Earth participants' differed from the 'ecosystem services view'. In
505 this respect UNESCO, having convened the Paris workshop, acted as a mediator and
506 facilitated interactions between the Bolivian delegation and other groups.

507 Many participants, including among ecosystem services experts, noted that their vision was
508 not that different from the one of Mother Earth advocates. They also recognize that
509 biodiversity has non-utilitarian values. However, they believed that, as highlighted above "it
510 is not a practical way"; the ecosystem services approach provides a more pragmatic,
511 framing. Experts among the ecosystem services community tried to convey this message:
512 "no one wants to commodify nature". They often expressed some frustration over the
513 refusal to adopt a common lexicon or terminology:

514 "There is quite a lot of refusal to understand the meaning of the words. You can go
515 through that explanation over and over again and people still oppose and revert to
516 their former positions, even though they have agreed that their position is not that
517 different. (…) You can't call them ecosystem services but you have to call them
518 "nature's benefits", and you know, what are nature's benefits to humans if not
519 ecosystem services?" (Interviewee D)

520 Despite numerous attempts to agree on a shared terminology, such convergence was not
521 possible and participants had to revert to using a colour coding as explained below.

522 **5. Discussion: what does the framework achieve?**
523
524 **5.1. Articulating multiple perspectives**
525

526 This absence of convergence – the lack of an agreement over a singular framing – is
527 illustrated by the very fact that a colour coding device was deemed necessary. The
528 controversy between Mother Earth and ecosystem services experts can be understood as
529 resulting from efforts by these two groups to constitute their own framing with what
530 perhaps bears some similarity with an *obligatory passage point* (Callon 1986). Each group
531 refuses to give up its framing for the same reason: they are each perceived as too political by

the other group. In this respect, the colour coding device – blue for Mother Earth, green for ecosystem services – appears as a solution to create an agreement out of disagreement, to create a consensus out of dissensus:

> "Text in green denotes the concepts of science; and text in blue denotes those of other knowledge-systems" (IPBES-2 Final report, p3)

The clever use of this colour code allows these two perspectives to coexist on the same diagram, to fit in the same boxes, thereby rendering them visually commensurable. By the use of this colour code, the IPBES conceptual framework recognizes both perspectives equally and legitimizes them.

In doing so, it also essentializes the distinction between science and indigenous and local knowledge (ILK), as if they were two clearly demarcated monolithic blocks:

> "Nature" in the context of the Platform refers to the natural world with an emphasis on biodiversity. *Within the context of science*, it includes categories such as biodiversity, ecosystems, ecosystem functioning, evolution, the biosphere, human kind, shared evolutionary heritage and biocultural diversity. *Within the context of other knowledge-systems*, it includes categories such as Mother Earth and systems of life" (UNEP 2014, p41; italics ours).

However such a clear discontinuity between science and ILK has been questioned, and from a STS standpoint all knowledge is unavoidably *situated* (e.g. Haraway 1988). The search for a demarcation criterion between scientific knowledge and traditional knowledge is still unresolved, or highly contested (Agrawal 1995; Turnbull 1997; Cruikshank 2005). According to these scholars there is no substantial difference between these knowledge-systems, both ILK and science can be approached as cultural practices first emerging in local settings, and "a characteristic [different knowledge-systems] all share is localness" (Watson-Verran & Turnbull 1995:116). The reification of these two distinct categories then raises questions regarding what this means for the kinds of knowledges recognized by IPBES in practice.

### 5.2 A boundary object?

If the distinction between ILK and scientific knowledge can be questioned, it is however true that the circulation of different knowledges is uneven. Some forms of knowledge are more easily decontextualized and travel better than others in global settings (Hulme 2010; Jasanoff 2010). In a recent paper Turnhout and colleagues develop the idea of "measurementality". Drawing on the Foucauldian idea of governmentality they suggest that underlying IPBES is a logic that tends to marginalize those forms of knowledge that cannot easily be translated into the ecosystem services approach (Turnhout et al. 2014). For this reason, an important question concerns whether the IPBES conceptual framework could act as a 'boundary object', facilitating such ontological manipulation and allowing different knowledges to enter into policy deliberation. According to Star and Griesemer, 'boundary

objects' are: "objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. (…) They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds" (Star & Griesemer 1989:393).

As outlined in this definition, one of the key dimensions of boundary objects is that they allow interpretive flexibility. They can be embedded with different meanings by distinct groups of actors. At the same time, they are necessary to ensure collaboration despite heterogeneity. The IPBES framework aligns with these criteria; while no consensus could be found at the inception of the process, the colour code allows different interpretations to co-exist. It also makes possible the continuation of IPBES work by providing a common framing for different groups of actors with multiple concerns. In this respect it stabilizes interactions between these groups and ensures that they can still work together:

> "The process of getting there was not easy, it was a very interesting process of negotiation between scientists who wanted to make very relevant points but who also had to compromise to be able to maintain a coherent and unified vision by many different types of scientists and people with very different understandings." (Interviewee C)

Star also points out that boundary objects must satisfy the informational requirements of the different groups of actors (Star 2010). In this respect, the framework was consciously designed as a device whose objective is to provide a common overarching vision for IPBES while being used to implement its programme of work (Díaz et al. 2015a; 2015b). The ambition is that this framework should serve as an articulation device – between theory and practice, between science and policy – and facilitate the implementation of common standards. IPBES is global in scope and there is a willingness to make its findings, or data, commensurable across regions. The conceptual framework was explicitly designed to shape the knowledge infrastructure of IPBES and is currently being used by the different groups of experts participating in IPBES (see UNEP 2015a; 2015b).

Yet, the resulting framework appears largely to be a negotiated outcome: a solution needed to be found and the colour code was an acceptable device to articulate different perspectives that could not easily have been articulated otherwise. Among participants, it is also widely acknowledged that the IPBES framework was a compromise:

> "To some degree it was a political solution because of, say, Bolivia, but actually now I quite like it. I think it talks to some degree to indigenous people, I think there is some people in Japan that think much the same – 'harmony with nature', it certainly hopes

to talk to Bolivia and a few other countries, not just Bolivia, and I don't think it sacrifices intellectual rigor at all. So I actually rather like it and to be honest it was an evolutionary process." (Interviewee I)

For this reason, while the IPBES framework may act as a stabilizing device, it is also a political solution which makes it unlikely that conflicts and contestations have completely disappeared – the coding device could be a 'magic trick'. If it is true that "in a biodiverse world we need to be able to manipulate ontologically different data" (Bowker 2000: 677), there remains some ambiguity about whether and how this is possible within the IPBES knowledge infrastructure and conflicts may have been displaced elsewhere. Yet, for now, some innovative, experimental, practices are being developed in IPBES: for example a task force on 'Indigenous & Local Knowledge' has been set up (Díaz et al. 2015a).

## 6. Conclusion

IPBES is an emerging institution of expertise, positioning itself at the science-policy interface. However, as the debates around the conception of the IPBES conceptual framework illustrate, this interface is being imagined in multiple ways and embedded with different meanings and concerns. This illustrates the difficulty of reconciling in the context of a single framework "all disciplined ways of knowing nature, as well as conceptualizing human-nature relationships" (Jasanoff 2004b:348). Overall, the debates that emerged in Paris, Bonn and Cape Town reflected competing interpretations of ecosystem services and what this approach to biodiversity entails in policy practice. But, even wider, they reflect disagreements about the nature of the IPBES conceptual framework and the form of science-policy relations that IPBES will endorse, the nature of science and its cultural authority, and who controls imaginaries of global planetary futures.

In the process leading to the adoption of the framework, efforts were made to be inclusive of a broad range of actors and to consider different perspectives on biodiversity. Two major expert workshops were organized, both of which convened fascinating debates regarding how to frame human-nature relations in the context of biodiversity issues. These have allowed interactions and dialogue to occur between groups of actors who are unused to working together. A major controversy arose between participants framing biodiversity through the utilitarian notion of "ecosystem services" and those framing biodiversity through the holistic notion of "Mother Earth". In this context, the role of mediating experts became critical: positioning themselves at the intersection between different social worlds these experts have built some bridges - for example between South American delegations and the community of ecosystem services scientists.

However, during this process there were important tensions between the willingness to adopt a single, consensual, framework and to overcome contestation and accommodate

different perspectives on the same diagram, a colour coding system was used. This clever device allows both perspectives to be made equally visible and legitimize them both. In doing so, the IPBES conceptual framework performs two important roles: (1) it acts as a stabilizing device, rather than an epistemic one, between groups of actors – while potentially hiding conflicts and dissent 'under the carpet'; (2) it recognizes explicitly multiple knowledge-systems (scientific knowledge and traditional and indigenous knowledge) and their equivalence – while essentializing their differences. If the framework proves itself to be a 'boundary object', it should facilitate the inclusion of different forms of knowledge, although as discussed in section 5, some ambiguity remains as to how this can be achieved.

This study of the making of the IPBES framework also suggests that the ecosystem services approach is not uncontested and resonates more strongly in some places and transnational scientific networks, than in others - South America and in parts of Asia (e.g. Japan). Similarly, Mother Earth may find an audience in South America while being contested or subtly resisted elsewhere. While the approved framework recognizes both perspectives symmetrically, an outstanding question concerns their potential asymmetry in practice: is "Mother Earth" a marginal position, a site of friction on the fringes of a vast "technological zone" (Barry 2006) constituted by ecosystem services? Or is "Mother Earth" a powerful counter-narrative to the assumed hegemony and utility of ecosystem services? IPBES is still at an early stage of development and it remains to be seen how these different perspectives will be enacted in epistemic and policy practices. Preserving this plurality of knowledge, captured in the IPBES conceptual framework, may well be the most important challenge for a democratic governance of global biodiversity

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## REFERENCES

Agrawal, A., 1995. Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change*, 26(3), pp.413–439.

Barry, A., 2006. Technological Zones. *European Journal of Social Theory*, 9, pp.239–253.

Beck, S. et al., 2014. Towards a reflexive turn in the Governance of Global Environmental Expertise. The cases of the IPCC and the IPBES. *GAIA, 23(2)*, pp.80–87.

Bjurström, A. & Polk, M., 2011. Physical and economic bias in climate change research: A scientometric study of IPCC Third Assessment Report. *Climatic Change*, 108, pp.1–22.

689 Bowker, G., 2000. Biodiversity Datadiversity. *Social Studies of Science*, 30, pp.643–683.

690 Callon, M., 1986. Some elements of a sociology of translation: domestication of the scallops
691 and the fishermen of St Brieuc Bay. In Law, J. (Ed) *Power, action and Belief: A new sociology*
692 *of Knowledge?* Routledge and Kegan Paul, London, pp. 196–223.

693 Callon, M. & Latour, B., 1981. Unscrewing the big Leviathan: how actors macro-structure
694 reality and how sociologists help them to do so. In Knorr-Cetina, K., Cicourel, A. (Eds)
695 *Advances in Social Theory and Methodology: Toward an integration of micro and macro-*
696 *sociologies*, Rouledge and Kegan Paul, London, pp.277–303.

697 Carpenter, S. et al., 2009. Science for managing ecosystem services: Beyond the Millenium
698 Ecosystem Assessment. *PNAS*, 106, pp.1305–1312.

699 Charmaz, K. 2006. *Constructing grounded theory: a practical guide through qualitative*
700 *analysis*, SAGE, London.

701 Clarke, A., 2005. *Situational Analysis: Grounded Theory After the Postmodern Turn*, SAGE.

702 Clarke, A. & Star, S., 2008. The Social Worlds Framework: A Theory/Methods Package. In
703 Hackette, J. et al (Eds) *The Handbook of Science and Technology Studies (3rd edition)*. MIT
704 Press, pp. 113–138.

705 Convention on Biological Diversity (CBD), 2010. Aichi Biodiversity Targets for 2011-2020.
706 Available at: http://www.cbd.int/sp/targets/

707 Cruikshank, J., 2005. *Do glaciers listen? Local knowledge, colonial encounters and social*
708 *imagination* UBC Press.

709 Díaz, S., Demissew, S., Joly, C., et al., 2015a. A Rosetta Stone for Nature's Benefits to People.
710 *PLOS Biology*, 13(1), p.e1002040.

711 Díaz, S., Demissew, S., Carabias, J., et al., 2015b. The IPBES Conceptual Framework —
712 connecting nature and people. *Current Opinion in Environmental Sustainability*, 14, pp.1–16.

713 Ernstson, H. & Sörlin, S., 2013. Ecosystem services as technology of globalization: On
714 articulating values in urban nature. *Ecological Economics*, 86, pp.274–284.

715 Fyfe, G. & Law, J., 1988. *Picturing Power: Visual Depiction and Social Relations* Routledge

716 Görg, C., Neßhöver, C. & Paulsch, A., 2010. A New Link Between Biodiversity Science and
717 Policy. *GAIA*, 19, pp.183–186.

718 Haraway, D., 1988. Situated Knowledges: The Science Question in Feminism and the
719 Privilege of Partial Perspective. *Feminist Studies*, 14(3), 575–599. doi:10.2307/3178066

720 Heywood, V. (Ed.), 1995. *Global Biodiversity Assessment*, Cambridge University Press.

721 Hulme, M., 2011. Meet the humanities. *Nature Climate Change*. 1(4), pp.177-179

722 Hulme, M., 2010. Problems with making and governing global kinds of knowledge. *Global*
723 *Environmental Change*, 20(4), pp.558–564.

724 Hulme, M. et al., 2011. Science-Policy Interface: Beyond Assessments. *Science*, 333 (6043),
725 pp.697–698.

726 Hulme, M. & Mahony, M., 2010. Climate change: What do we know about the IPCC?
727 *Progress in Physical Geography*, 34, pp.705–718.

728 IPBES, 2012. *Functions, operating principles and institutional arrangements of the*
729 *Intergovernmental Platform on Biodiversity and Ecosystem Services (as adopted in Panama,*
730 *April 2012)*, Available at: http://www.ipbes.net/images/Functions operating principles and
731 institutional arrangements of IPBES_2012.pdf.

732 IPBES, 2013. *Rules of procedure for the plenary of the Platform*, Available at:
733 http://www.ipbes.net/images/Rules of procedure for the Plenary of the Platform_2013.pdf.

734 Jasanoff, S., 2010. A New Climate for Society. *Theory, Culture & Society*, 27(2-3), pp.233–253.

735 Jasanoff, S., 2004a. *States of Knowledge: The Coproduction of Science and Social Order*.
736 Routledge.

737 Jasanoff, S. & Martello, M., 2004b. *Earthly politics: local and global in environmental*
738 *governance*, MIT Press.

739 Koetz, T., Farrell, K. & Bridgewater, P., 2011. Building better science-policy interfaces for
740 international environmental governance: assessing potential within the Intergovernmental
741 Platform for Biodiversity and Ecosystem Services. *International Environmental Agreements:*
742 *Politics, Law and Economics*, 12, pp.1–21.

743 Larigauderie, A. et al., 2012. Biodiversity and ecosystem services science for a sustainable
744 planet: The DIVERSITAS vision for 2012-20. *Current Opinion in Environmental Sustainability*, 4
745 (1), pp.101–105.

746 Larigauderie, A. & Mooney, H., 2010. The Intergovernmental science-policy Platform on
747 Biodiversity and Ecosystem Services: moving a step closer to an IPCC-like mechanism for
748 biodiversity. *Current Opinion in Environmental Sustainability*, 2(1-2), pp.9–14.

749 Mace, G., Norris, K. & Fitter, A., 2012. Biodiversity and ecosystem services: A multilayered
750 relationship. *Trends in Ecology and Evolution*, 27, pp.19–25.

751 Millennium Ecosystem Assessment, 2003. *Ecosystems and Human Well-being: A Framework*
752 *for Assessment*, Island Press, Washington.

753 Mooney, H., Duraiappah, A. & Larigauderie, A., 2013. Evolution of natural and social science
754 interactions in global change research programs. *PNAS*, 110 (supplement 1), pp.3665–72.

755 Ostrom, E., 1990. *Governing the Commons*, Cambridge: Cambridge University Press.

756 Ostrom, E., 2010. Polycentric systems for coping with collective action and global
757 environmental change. *Global Environmental Change*, 20 (4), pp.550–557.

758 Palsson, G. et al., 2013. Reconceptualizing the "Anthropos" in the Anthropocene: Integrating
759 the social sciences and humanities in global environmental change research. *Environmental*
760 *Science & Policy*, 28, pp.3–13.

761 Plurinational State of Bolivia, 2013. *Conceptual framework for the Intergovernmental*
762 *Science-Policy Platform on Biodiversity and Ecosystem Services*, Available at:
763 http://www.ipbes.net/images/documents/Bolivia_comments%20on%20background%20doc
764 ument%20on%20IPBES%20Conceptual%20Framework.pdf

765 Plurinational State of Bolivia, 2010. *Law of the Rights of Mother Earth (Law 071).*

766 Scoones, I., 2009. The politics of global assessments: the case of the International
767 Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD).
768 *Journal of Peasant Studies*, 36(3), pp.547–571.

769 Sörlin, S., 2013. Reconfiguring environmental expertise. *Environmental Science & Policy*, 28,
770 pp.14–24.

771 Star, S., 2010. This is Not a Boundary Object: Reflections on the Origin of a Concept. *Science,*
772 *Technology & Human Values*, 35(5), pp.601–617.

773 Star, S.L. & Griesemer, J.R., 1989. Institutional Ecology, `Translations' and Boundary Objects:
774 Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39*. Social*
775 *Studies of Science*, 19(3), pp.387–420.

776 Stirling, A., 2008. "Opening Up" and "Closing Down." *Science, Technology & Human Values*,
777 33(2), pp.262 –294.

778 Turnbull, D., 1997. Reframing science and other local knowledge traditions. *Futures*, 29(6),
779 pp.551–562.

780 Turnhout, E. et al., 2012. Conservation policy: Listen to the voices of experience. *Nature*, 488
781 (7412), pp.454–455.

782 Turnhout, E. et al., 2013. Rethinking biodiversity: from goods and services to "living with."
783 *Conservation Letters*, 6(3), pp.154–161.

784 Turnhout, E., Neves, K. & de Lister, E., 2014. “Measurementality” in biodiversity governance:
785 knowledge, transparency, and the Intergovernmental Science-Policy Platform on Biodiversity
786 and Ecosystem Services (IPBES). *Environment and Planning A*, 46(3), pp.581–597.

787 United Nations Environment Programme (UNEP), 2013a. *Outcome of an informal expert*
788 *workshop on main issues relating to the development of a conceptual framework for the*
789 *IPBES* (IPBES/1/INF/9), Paris (France).

790 United Nations Environment Programme (UNEP), 2013b*. Report of the Expert Workshop on*
791 *the Conceptual Framework for IPBES*, Cape Town (South Africa), 25-26 August.

792 United Nations Environment Programme (UNEP), 2014. *Report of the second plenary session*
793 *of the plenary of the Intergovernmental Platform on Biodiversity and Ecosystem Services*
794 (IPBES/2/17), Antalya (Turkey), 9-14 December 2013.

795 United Nations Environment Programme (UNEP), 2015a. *Preliminary guide regarding diverse*
796 *conceptualizations of multiple values of nature and its benefits, including biodiversity and*
797 *ecosystem functions and services* (IPBES/3/INF/7), 95pp.
798
799 United Nations Environment Programme (UNEP), 2015b. *Guide on the production and*
800 *integration of assessments from and across all scales* (IPBES/3/INF/4), 157pp.
801
802 Watson-Verran, H., & Turnbull, D. (1995). Science and Other Indigenous Knowledge Systems.
803 In *Handbook of science and technology studies* (pp. 115–139